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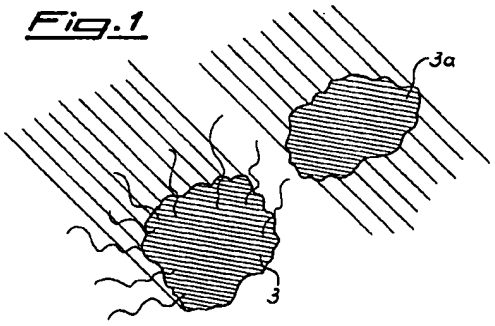
(54) Quantum energy therapeutic biostimulation method and apparatus.

(57) Human or animal tissue contaminants, such as cancer cells or viruses, are selectively removed from tissues by staining them with chromophores or similar energy transferring compounds and irradiating the stained elements with uniform laser light in a wavelength that is absorbed by the chromophore but is not significantly absorbed by surrounding health tissue; the energy released as heat by the chromophore to the contaminant is sufficient to irreversibly damage the contaminant.

Fig.1



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The present invention relates to a method and an apparatus for removal of contaminants from human and animal, tissues. The method and apparatus are particularly useful for treatment of tumors.

In medical circles, it is well known the widely proven regression effect produced on primary and secondary tumors by hyperthermia.

Many studies, both biological and clinical, have been successfully completed, relying on localized or total-body hyperthermia.

However the success rate, although non-negligible, is absolutely unsatisfactory; the percentage of patients showing total remission, without metastases originated recurrence, is too low to qualify this particular therapy as a basis for a cure.

The reason for such a low efficacy cannot be attributed to an unpredictable mechanism, upon which the treatment is based, since heat induced cell necrosis is a well known fact, no longer debatable. The reason why hyperthermia, as cancer therapy, is only occasionally successful originates from the fact that it relies on too small a difference in irreversible-damage threshold-temperature between normal and neoplastic cells.

Such restriction is a necessary precaution for the safety of the patient, since no method nor machine exists, as at today, to deliver the required heat only to the malignant presence in the body.

The use of elevated temperature for the treatment of cancer goes back to ancient times as total-body hyperthermia, while localized hyperthermia is a product of relatively recent times, utilizing Radio Frequency or Microwave technology and even laser energy sources.

But again all of the above rely on the indiscriminate exposure of tissue to elevated temperature and are therefore restricted in scope because they must rely exclusively on the questionable and variable higher sensitivity to temperature displayed by malignant tumors.

More recently fractionated doses of Radiofrequency Hyperthermia have been proven effective, still relying on the assumed greater heat sensitivity of neoplastic growth; the procedures and results are described in Journal of Dermatol. Surg. Oncology, Vol. 15 pages 845 to 849 (1989), in an article entitled "Radiofrequency Hyperthermia Therapy of Murine Melanoma: A Comparison of Fractionated Versus Single-Dose Treatments".

However even if encouraging, still the method is clumsy and it is not backed by the existence of a commercially viable hardware system.

Although still experimental, one commercially available technique called Photodynamic Therapy appears to resemble very closely the hereby introduced method (i.e. QUETBISM), but at the same time is totally off this target and it is also missing a truly effective hardware system.

However Photodynamic Therapy, like QUETBISM, is also taking advantage of the already mentioned fact that cancerous cell tend to retain chemicals and chromophores much longer than healthy tissues. On the other hand Photodynamic Therapy is relying on an alleged chemical reaction which supposedly occurs when HPD retaining tissue is exposed to light of a specific wavelength, as described in many published Research papers one of which is: "Pharmacological Modulation of Photodynamic Therapy with Hematoporphyrin Derivative and Light" appearing in "Cancer Research", Vol 47, pages 971-974 (1987). As an alternative cancer treatment this therapy method is offered to the public by QLT of Vancouver, BC.

Finally, the ability to selectively affect stained tissue, under illumination by laser light of adequate wavelength, is empirically confirmed with a research report, herein enclosed by reference, published in the Proceedings of the National Academy of Science, USA, Vol. 85, pages 5454-5458 (Aug 1988) and entitled: "Selective Destruction of Protein Function by Chromophore-Assisted Laser Inactivation".

There are several objectives to the present invention and they may be summarized as follows:
First objective is to provide a self sufficient non-synergetic technique for the effective obliteration of unwanted extraneous presence in the human or animal tissues, tumor growth or viral contaminants that they might be; such therapy is in fact called Enhanced Hyperthermia. With "tissues" is here meant any aggregation of cells besides body tissues, i.e. also blood.

Second objective is to provide the apparatus necessary to implement such method; namely: the opto-electronic hardware (LAILT System).

Third objective is to provide the subsystem capable to deliver the required energy to any location of interest within the body, for the treatment of malignant growths.

Fourth objective is to provide the modification to the main hardware system required to transform it from a Cancer Treatment Device to a Blood Viral Contaminants Treatment Device; namely: the variations between the LAILT System I and II.

The final objective is to establish guidelines on the type and characteristics of the family of non-toxic compounds which may be used to correctly implement the Enhanced Hyperthermia Treatment.

The above stated objectives were achieved by the present invention, that provides a method of selectively removing cellular or viral contaminants from human or animal tissues according to claim 1.

The invention also provides an apparatus for performing above method, according to claim 6.

Moreover, the invention relates to a method of cosmetic treatment of human or animal skin according to claim 17.

The invention being discussed has taken all the positive aspect of recent research efforts and presently used techniques and has given life to the method according to present invention, i.e. Enhanced Hyperthermia, which combines the guiding principles of most of the existing methods with the simple Quantum Physics' principle of Blackbody radiation.

Selective targeting of only malignant tissue is achieved through the widely utilized standard method of neoplastic tissue tagging, followed by illumination with Quantum Energy, namely laser light of a wavelength not readily absorbed by live tissue, under normal circumstances.

Requirement on the tagging agent are: nontoxicity to human cells and a spectrum of absorption with a maximum in the frequency range of the light source utilized.

Final and main feature, that gives the invention a practical general use, is the invention apparatus, i.e. the LAILT System, which can deliver laser light to any desired physical location and selectively produce irreversible damage to cell protein, without causing charring or secondary damage, on account of design features which render the power output controllable and uniformly distributed.

The invention will now be disclosed in further detail with reference to accompanying and non limiting drawings, where:

- FIG.1 is an elementary visualization of the mechanism of light absorption by tissues with different pigmentation.
- FIG. 2 is a diagram visualization of an embodiment of the invention, with a symbolic number of array sources for monochromatic light.
- FIG. 3 is a schematic representation of a preferred embodiment of an individual channel's driver circuit.
- FIG. 4-7 are a schematic representation of a preferred peripheral attachment for proper delivery.
- FIG. 8 is a diagram of a modified internal layout, required for a different application of the invention.

From the medical point of view, the invention takes into account what has been done to this point in the treatment of cancer, combines several partially successful approved techniques and brings the entire ensemble a step forward, above and beyond what each and every method was intended or has been interpreted to be doing, and so arrives at a successful solution which has a full theoretical explanation.

From the technology point of view, the invention is taking semi off-the-shelf opto-electronic components and is utilizing them in a manner different enough from standard procedures to create new and inventive method (QUETBISM) and apparatus.

As already pointed out QUETBISM represents the method for delivery of an improved form of hyperthermia, identified by the inventors with the name of "Enhanced Hyperthermia".

Based on sound and already proven principles of physics and biology, QUETBISM produces Enhanced Hyperthermia within a specific target, through the utilization of one of the LAILT Systems.

The actual bio-mechanism requires the intra venous injection of a chomophore carrying compound, which is non-toxic and does not causes any particular chemical reaction within the tissue, but simply delivers the stain to the general location.

Based on an important finding already widely exployted in many other cancer treatments, after a waiting period of 36 to 48 hours, healthy cell will have eliminated the compound from their structure, while the sick cells will not have. Therefore they will maintain a different index of absorption, at least for light of the selected wave length.

The LAILT apparatus will then be used to illuminate the general area and, since its wavelength was specifically selected to be in a range of negligible absorption by normal tissue, only the abnormal cells 3, retaining the stain, will reach the target temperature of 50 degrees Celsius.

At such temperature cell necrosis is certain; however the surrounding healthy cells 3a, now free of stain, will not be able to reach a temperature greater that 42-43 degrees Celsius, which is still within a safe margin for survival, especially for normal cells (fig. 1).

For these reasons, this innovative treatment will not require the assistance of imaging devices, nor it will require the incorporation of temperature monitoring instruments.

The LAILT apparatus is designed to safely deliver, to the general surroundings of a targeted area, a controlled amount of energy low enough to cause only minor discomfort and totally reversible damage, if any, to healthy tissue but sufficient to produce irreversible damage to regions displaying abnormal index of absorption, artificially induced with the tagging process.

This goal cannot be achieved with the assistance of any traditional laser system, presently used in medicine.

The LAILT System I is so compact that it may be contained in a metal casing with the approximate size of 47x31x18 cm and may be carried in a compact suitcase or a slightly oversized attache; it is designed (fig. 2) to plug directly on an ordinary

120 (or 220) Volt standard wall outlet and does not require an actual cooling system. The electrical cord 22 coming from the wall outlet 23 feeds both a series of independent power supplies 24 and a DC transformer 25. The transformer feeds two mini fans 26, which represent the only cooling apparatus needed. Each power supply feeds the driver circuits of three channels 27; where the word channels is here used to identify the laser energy sources.

Consequently the actual number of power supplies depends solely on the number of channels used in the system, which in turn depends on the specific application.

The energy sources in question are in fact semiconductor lasers of high output and uniform, unfocused far field pattern, with an output rating of at least 200 mW at the window or fiber tip, depending on the application.

For the LAILT System I, the semiconductor lasers utilized, also called laser diodes because of their design layout, have a fiberoptic line 15 approximately one (1) meter long or thereabout attached at the emission window; the rated output at the laser light emission sources 28, i.e. the tips of the fibers, is in the general range of 150-300 mW.

However for the specific need of the Enhanced Hyperthermia treatment, the devices are not driven to their maximum rating since, for curative purposes, it is not necessary to induce tissue charring.

Each laser is independently powered by a separate driver circuit 1, (fig. 3), to take into account and be protected from individual minor variation in rating; so that each channel can deliver on tissue an equal amount of power and the combined output beam can furnish to the illumination area a uniform amount of energy.

Each driver circuit is also provided with safety oriented filtering features, to eliminate the costly possibility of damage to the very sensitive semiconductor lasers.

Said circuits are also equipped with an input power control device (not shown), manually operated and accessible from a numbered nub on the external top portion of the casing, below each numbered meter, in turn intended to provide visual confirmation of the exact amount of input provided to each and every energy source.

The identical driver circuits 1 are at this point very simple, efficient and to the point. At a later date, they will eventually be improved to render the LAILT System more user friendly; but the basic structure will remain unchanged because it is capable to guarantee safe and controlled operation of the system. More specifically, the basic circuitry comprises : control means 4,5 to control the voltage drop from power source to semiconductor laser; protecting means 6,7 to protect said semiconductor laser 8 from current surges and voltage spikes; filtering means to protect the semiconductor laser from ground surges and spikes; and control means 10-13 to control biasing of semiconductor laser.

As it is clearly comprehensible from the schematic in FIG. 3, the input power from 2 is controlled with variable resistor 5 followed by diode 4, whose presence only serves to ensure finely adjusted voltage drop.

At point A the line separates into three parallel resistor networks, in this way effectively dividing the total current into branches of appropriate level. This is done to provide the semiconductor laser 8 with correct biasing and a variable drive current, which in turn permits operation of said laser throughout its full range of output capability.

The branch including connection point C is the one containing the semiconductor laser and, for reasons already indicated, it is designed to see a current flow variable from the lasing threshold of approximately 175 mAmps to the maximum allowable of approximately 800 mAmps.

The branch containing connection point B includes one fixed resistor 11 and a variable one 12, in addition to one Amp meter 14.

The presence of this parallel branch serves the double purpose of providing an adjustable current shunt for the semiconductor laser as well as an indirect monitor of the diode's drive current.

Fixed resistor 11 establishes the minimum conductance (G) of this branch, while variable resistor 12 allows for adjustments. An increase in the value of 12 causes an increase in the laser's drive current, while a decrease in the value of the same resistor produces a reduction in laser light output power.

The meter 14 following 12 allows the trained user to monitor the channel, by determining the semiconductor laser's drive current through a simple subtraction of the value indicated by the meter from the known total current.

In the branch containing the laser, coil 7 is incorporated to delay any eventual surge current, until the Zener Diode 6 has the opportunity to turn on and divert from the very sensitive light source 8 any voltage spike.

Additionally diode 9 is located on the cathode side of the semiconductor laser to filter out ground surges and spikes.

Variable resistor 13 is incorporated to allow for finer tuning of current adjustments in both B and C branches.

The three parallel branches rejoin at point E, proceed to include point F in their path and finally flow through fixed resistor 10, which in conjuntion with the total resistence of of the three branch circuit helps establish proper loading of the power

supply.

To allow proper monitoring of each branch from the external side of the casing and only as an additional precaution, two LED are added to circuit with relative biasing resistors to merely confirm that current is actually flowing through the whole circuit and the branch containing the laser. No illuminating signal is necessary in the third branch, since the meter itself is the utilized indicator.

Finally and not shown in any of the drawings, for the LAILT System I only the Quantum Energy emerges from the tip of a fiberoptic line installed as part of the Semiconductor laser at the original manufacturer's site.

The central feature, without which the proper delivery of Enhanced Hyperthermia would not be possible, and, at the same time one of several technological innovations in the LAILT System, is the presence of multiple fiberoptic guided beams of nearly identical power, originating from distinct individually driven laser energy sources, which ensure uniform distribution of power within the illuminated region.

The latter characteristic is vital for the certain acquisition of the target temperature (50 degrees Celsius) by tagged tissue only, as the only way to ensure its total necrosis.

Systems equipped with multiple fiberoptic lines, utilizing the electromagnetic energy originating from one single powerful laser source, cannot allow for proper control of the output power.

In other words, the present invention apparatus provides also a method for the generation of uniform and unfocused monochromatic laser light and irradiation by the same of an extended area.

The other key factor is the utilization of semiconductor laser technology, which not only provide monochromatic radiation, in the exact range not significantly absorbed by human tissue under normal circumstances, but it also renders possible the design of an "Array of Arrays", namely the LAILT System, which, even as a system of multiple laser sources, displays very limited input power consumption, and it is easily transportable, practical, does not require a clumsy cooling apparatus and is still of reasonable cost, contrary to what a system of multiple traditional lasers would be.

In the preferred embodiment the two fans 26 are strategically positioned, with respect to driver circuits, to provide spread and uniform ventilation of the array of said circuits 27. Each laser source is firmly resting on the already mentioned angled heat sinks, and as a whole are positioned in apparent disorderly fashion; in reality the distribution has been so designed to ensure that there is a reasonably close distance covered and a minimum overlapping in the fiber path, as they come together in a bundle and are so directed toward the exit opening positioned to the side of the casing. This distribution is the most adequate and consistent with the need to limit the spacial demands. Finally, at the exit point in the casing, the fiber bundle is firmly braced to the internal side of the apparatus external packaging, for the sole purpose of limiting the stress, deriving from motion in repeated usage, on the fiber optic attachement located for each laser source at the window of emission.

In the LAILT apparatus to be used for the treatment of melanoma the delivery attachment will be as represented in FIG. 4 to 7, where a plexiglass tube 17 is used to guide, separate and maintain securely in place the various fiber lines 15.

This goal is achieved with a multi sections (three to five or possibly more) solid acrylic tube 17, where channels 18 have been etched for the passage of the fibers 15 in a smoothly progressive diverging fashion at first, until appropriate separation has been achieved and subsequently in a collimated pattern until the exit opening 19 is reached; at said opening the tip 16 of the optical fiber protrudes from the channel and is kept away from direct contact with the tube by means of an enlarged cone shaped channel end 19, and from the surface of the skin by a simple base collar cladding 20 doubling also as stand thanks to a cone shaped end portion 21. All the above features in the design of the delivery attachment are necessary precautions not only for the convenient handling of the tool, but especially to ensure that the tips of the various fiber lines do not come in direct contact with each other or the surface of the skin and do not in this way cause self damage nor generate unnecessary overheating of the target.

The total length of the delivery tubule is approximately 13 cm and the various sections snap into place through the use of incorporated pins 17a.

Finally the tagging agent necessary to alter the index of absorption of the neoplastic tissue is not a uniquely identified nor an exclusive product, since no specific or obscure chemical reaction are at the basis of the process.

Again all is required of any adequate product is to be capable to carry an energy transferring compound, that is preferably a chemically inert and pharmaceutically acceptable chromophore, to the desired site, which does not need precise spacial identification, but merely an approximate one simply pointing to the general region.

Restrictions on the chromophore are: non toxicity to the human body and most preferably a shade of eighter green or black coloration. In the studies reported in the previously mentioned article discussing chromophore-assisted laser inactivation and during that particular research effort, Malachite Green was used as stain in question, but, although

within the acceptable chromatic range, malachite green is not proven to be totally non-toxic to the body.

In vivo and in vitro tests were carried out according to the following examples.

Example 1

In vivo tests were effected according to the following procedure :
Subject, caucasian adult male, displaying a tattoo on the right forearm, agreed to serve as volunteer in a verification test. In this case, the contaminants, i.e. colored cells forming the tattoo pattern, were already stained by the tattoo ink : Therefore, no staining step was required.

Without receiving general or local anesthetic of any type or form, he exposed the general area of interest in the forearm to illumination from the fiber tip bundle located at about 1.5 cm distance from the skin surface. Since the general area of interest was much larger than the illumination spot originating from the apparatus, the exposed portion was methodically shifted after a time interval averaging approximately 20 seconds. Since illuminated spot temperature monitoring was not possible under such test conditions, simply from the observed effect on the stained skin portion only, it was possible to conclude that the temperature reached must have been in the range of 60 °C.

More significantly, the results of the in-vivo testing were that the cells carring green ink were irreversibly damaged, actually displaying excessive burning, while the surrounding unstained cells concomitantly exposed to the same illumination pattern, did not suffer any reportable disconfort nor displayed at any time any form of damage.

This was done to demonstrate that any product of the adequate color will produce the wanted result and that its selection would be mere a matter of preference or practicality. Possible application of the invention to cosmetic treatment of skin is apparent from this test.

Example 2

In vitro tests were effected according to the following procedure.

About 0.5 cc of Agar gel were stained with a 5%concentration of McCornic Food Coloring containing FD&C Yellow # 5 and FD&C Blue #1. The stained Agar gel was exposed to illumination from the invention apparatus, utilized with an output of 200 milliWatts, from a 1.5 cm distance for 90 seconds time interval and longer. A thermocouple tip immersed in the gel was used for immediate and correct temperature read-out.

An equal volume of unstained Agar gel was also subjected to identical condition of exposure.

The results showed that stained Agar gel did reach a 50 °C temperature within the initial 90 seconds, while non stained agar gel did not go above the 43 °C mark, even well beyond the 90 sec. time limit.

In the actual treatment of patients it will preferably be used a more convenient compound, like one of the stain already used for the visualization of cancer; one of which is the one identified by the name of "Fresh Green".

Similarly, it will also be preferred the use of some of the products which display affinity to highly acid tissue as cancer and are used to quickly identify the neoplastic site, without the need of a waiting period.

According to another preferred embodiment of the invention, these products will be admixed with a color in the proper range, to actually shorten the waiting period prior to illumination treatment.

The same principle and technique may be applied in the elimination of viral contaminant in the blood, although a very different delivery apparatus will be needed in such a case.

Again, in this different application, the main structure of the LAILT System remains unaltered and so do the various driver circuits; only the internal arrangement of the "Array of Arrays" is modified, as shown in the black box diagram of FIG. 8. The differences from the previously disclosed embodiment are that laser sources A to L do not need to be oriented in a distance balancing fashion, since slightly different semiconductor lasers are utilized in this design and therefore it is only necessary to provide uniform illumination of the target. The difference in these laser sources only applies to the external packaging and it refers to the fact that they do not carry a fiberoptic attachment and relative fiber, but they simply possess an emission window from where the beam irradiate with a far field pattern of slightly oval cross-section instead of the circular one of the output from the fiberoptics. However, in this case the exiting beam retains the coherency characteristic of lasers, which is lost in the case of devices provided with fiberoptic lines. Finally, the sources will be resting on ordinary heat sinks with emission windows facing upward, immediately below a clear window area in the apparatus casing.

Claims

1. A method of selectively removing cellular or viral contaminants from tissues of human or animal patients in the need thereof, by hyperthermia therapy, characterized in comprising the steps of :

selectively staining, if necessary, said contaminants by means of an energy transferring compound; and
irradiating the tissue area containing said contaminants with uniform, unfocused laser light of a wavelength that gives rise to absorption by said energy transferring compound but is not substantially absorbed by surrounding non-stained tissue, said irradiation being carried out for a time sufficient to have said energy transferring compounds release energy to stained contaminants to heat them at least to a temperature resulting in their irreversible damage.

2. A method according to claim 1, wherein said energy transferring compound is a chemically inert chromophore and selective staining is obtained by selective retention of said chromophore by contaminants.

3. A method according to claim 2, wherein contaminants are cancer cells.

4. A method according to claim 3, wherein said chromophore is administered by intra-venous injection.

5. A method according to any previous claim, wherein said laser light has an output within the range from 100 to 300 milliWatts.

6. An apparatus for selectively removing cellular or viral contaminants from human or animal tissues by hyperthermia therapy, characterized in that it comprises a plurality of distinct laser light generating means for generating laser light having wavelength that is not significantly absorbed by health tissues and a plurality of light delivery means for uniformly irradiating an area of said tissues with said laser light.

7. An apparatus according to claim 6, wherein said laser light generating means is a semiconductor laser.

8. An apparatus according to claim 7, wherein each semiconductor laser is connected to a separate driver circuit.

9. An apparatus according to claim 8, wherein said driver circuit comprises : control means (4,5) to control the voltage drop from power source to semiconductor laser; protecting means (6,7) to protect said semiconductor laser (8) from current surges and voltage spikes; filtering means to protect the semiconductor laser from ground surges and spikes; and control means (10-13) to control biasing of semiconductor laser.

10. An apparatus according to claim 9, wherein said control means for controlling voltage drop comprises a variable resistor (5) and optionally a diode (4), said protecting means comprises an impedance coil (7) and a zener diode (6), said filtering means comprises a diode (9), and said biasing control means comprises one or more fixed resistors (10,11) and one or more variable resistors. (12,13).

11. An apparatus according to claims 9 or 10, further comprising an ammeter (14) or similar drive current monitoring means.

12. An apparatus according to any claim 6 to 11, wherein said delivery means comprises a plurality of optical fibers (15) connected to the light output of each semiconductor laser (8).

13. An apparatus according to claim 12, further comprising housing means to individually house and separate from each other the tips (16) of said optical fibers and their end portions.

14. An apparatus according to claim 13, wherein said housing means comprises a tube (17) having a plurality of channels (18) each housing one optical fiber (15), each channel having a cone-shaped end portion (19) housing said fiber tip (16) without contacting it and in spaced relationship with respect to the patient skin.

15. An apparatus according to claim 14 wherein said tube (17) is provided with a cladding (20) having cone-shaped end portion (21).

16. An apparatus according to claims 14 or 15, wherein said tube (17) comprises a plurality of sections.

17. A method for the cosmetic treatment of human or animal skin by removal of irregularly or undesirably pigmented areas, characterized in that it comprises the steps of :
detecting the maximum wavelength absorption of laser light by said skin areas; optionally staining said areas with a chromophore or similar energy transferring compound; and irradiating a skin portion containing the said skin area with uniform, unfocused laser light of a wavelength that gives rise to absorption by said skin areas or by said energy transferring compound but is not significantly absorbed by surrounding correctly pigmented skin.

18. Pharmaceutically acceptable tagging compounds for cancer cells visualization for use as energy transfer compounds for irradiation with laser light.

19. The use of tagging compounds according to claim 18, in combination with pharmaceutically acceptable chromophores.

Fig.1

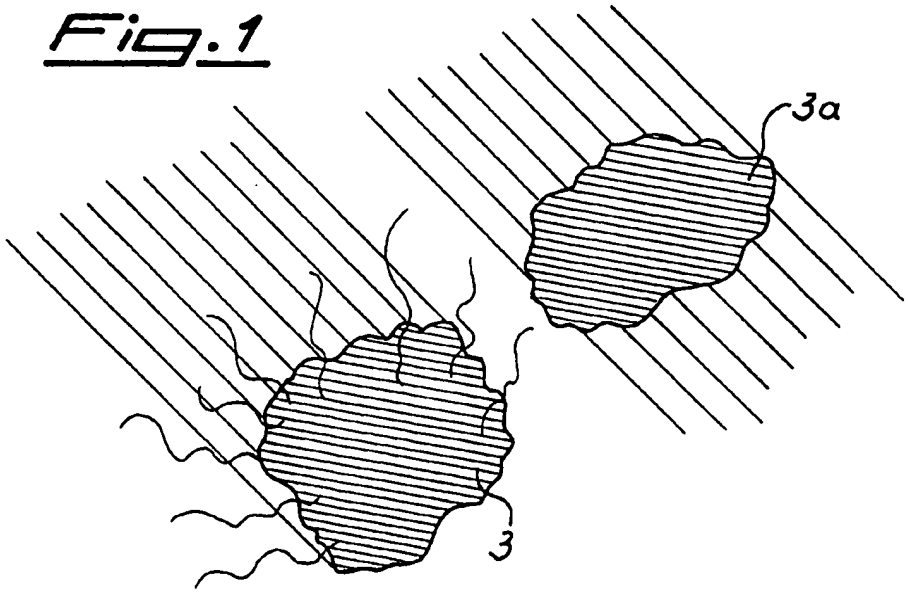


Fig.2

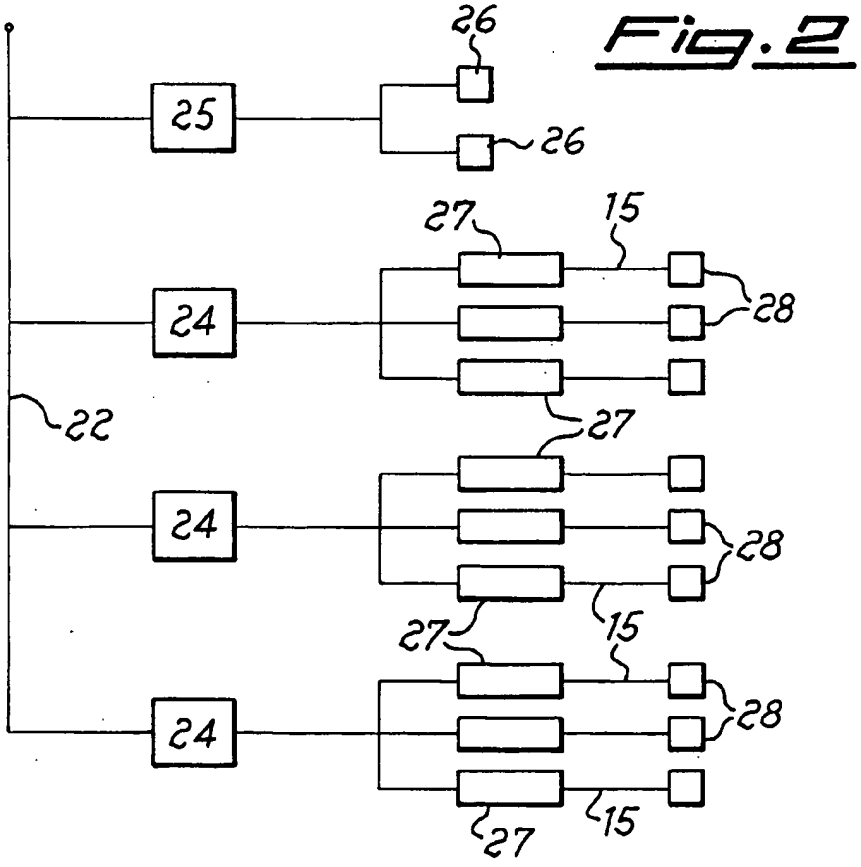


Fig. 3

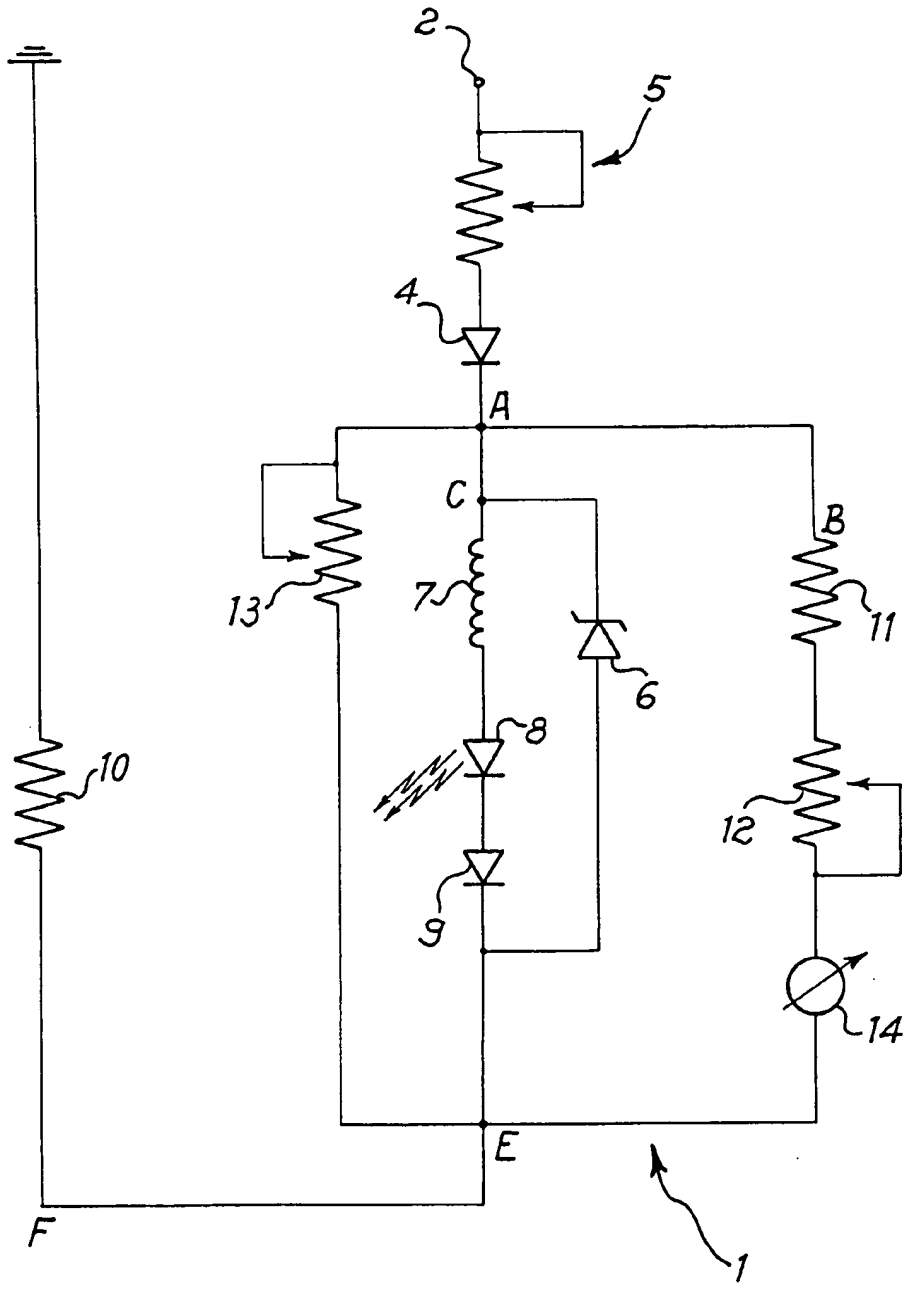


Fig.4

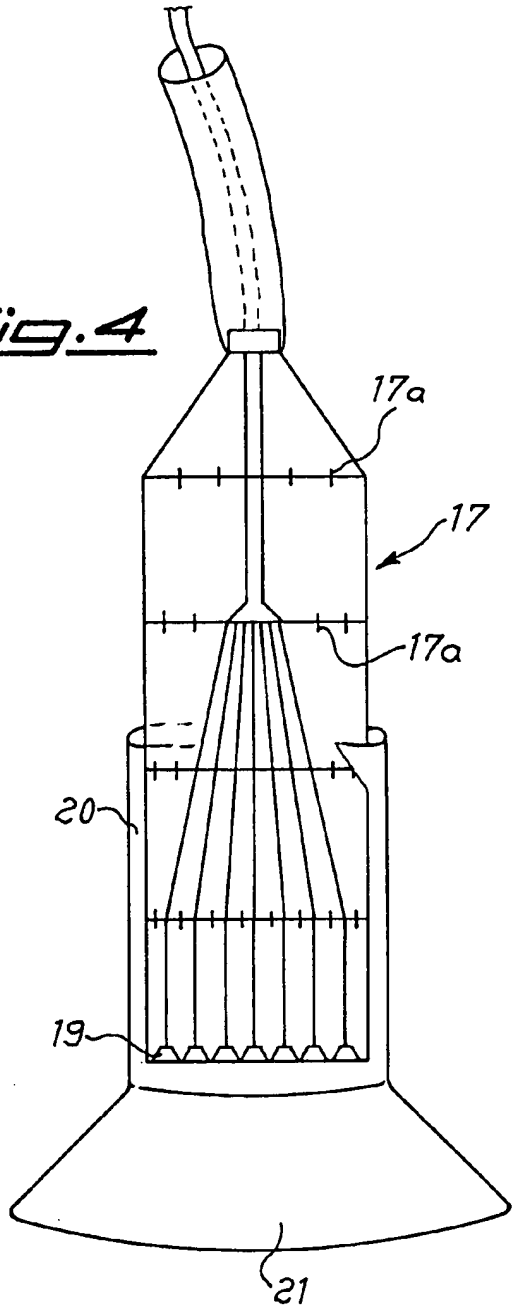


Fig.5

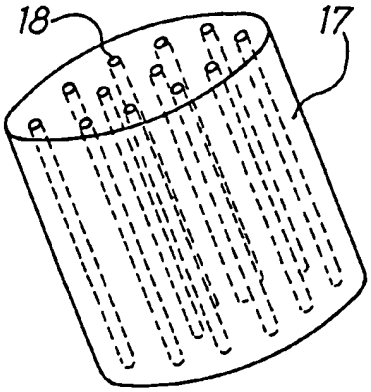


Fig.6

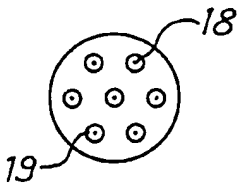


Fig.7

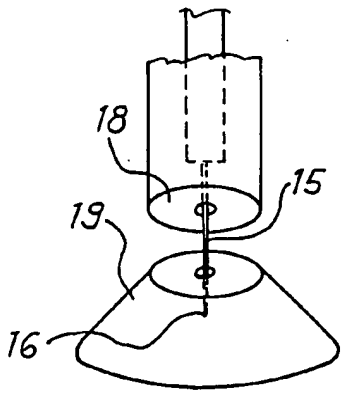
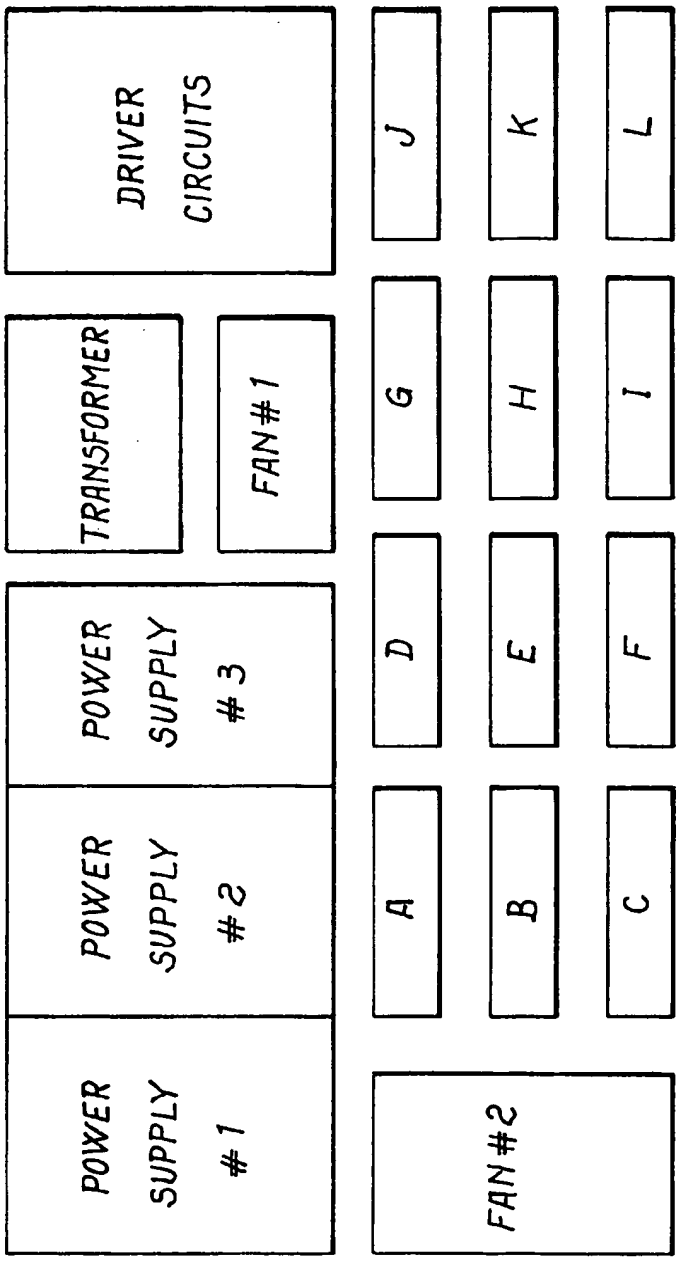


Fig. 8



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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1-24. (cancelled)

25. (new) A mechanically expandable interbody spinal fusion implant adapted for expansion after insertion across a disc space between adjacent vertebral bodies of a human spine, the vertebral bodies having an anterior aspect and a posterior aspect, said implant comprising:

a leading end for insertion first into the disc space and a trailing end opposite said leading end, and a length defined between said leading and trailing ends;

opposed upper and lower portions between said leading and trailing ends, said portions being adapted to contact one each of the adjacent vertebral bodies to be fused, said upper and lower portions being movable relative to one another, said upper and lower portions having at least one opening therethrough, said openings being in communication with one another to permit for the growth of bone from adjacent vertebral body to adjacent vertebral body through said implant;

a first height perpendicular to the length of said implant as measured by the maximum distance between said upper and lower portions when said implant is in a first and collapsed position;

a second height perpendicular to the length of said implant as measured by the maximum distance between said upper and lower portions when said implant is in a second and expanded position; and

an expander adapted to move said portions from the collapsed position to the expanded position to increase the height of said implant.

26. (new) The implant of claim 25, wherein the first and second heights are measured at said leading end of said implant.
27. (new) The implant of claim 25, wherein the first and second heights are measured at said trailing end of said implant.
28. (new) The implant of claim 25, wherein the first height measures the same at said leading and trailing ends of said implant.
29. (new) The implant of claim 25, wherein said leading and trailing ends are the same height in the collapsed position.
30. (new) The implant of claim 25, wherein the second height measures the same at said leading and trailing ends of said implant.
31. (new) The implant of claim 25, wherein said leading and trailing ends are the same height in the expanded position.
32. (new) The implant of claim 26, wherein said implant expands in height without expanding in width.
33. (new) The implant of claim 25, wherein said implant has a constant width when transitioning between the collapsed height and the increased height.
34. (new) The implant of claim 25, wherein said expander is adapted to hold said implant in the expanded position.
35. (new) The implant of claim 25, wherein said expander comprises a mechanism for expanding said implant.
36. (new) The implant of claim 35, wherein said expander mechanism is adapted to cooperatively engage a tool used to move said expander from the collapsed position to the expanded position to increase the height of said implant, said tool not being a part of said implant and being removed from said implant after moving said expander into the expanded position.
37. (new) The implant of claim 25, wherein said expander comprises a screw.
38. (new) The implant of claim 25, wherein said expander has a body with a threaded opening therein, said expander having a threaded screw adapted to cooperatively engage said threaded opening in said body.

39. (new) The implant of claim 38, wherein said expander contacts said upper and lower portions such that upon rotation of said screw, said body moves relative to said upper and lower portions to move said implant from the collapsed position to the expanded position.

40. (new) The implant of claim 25, wherein said expander is rotated to move said implant from the collapsed position to the expanded position.

41. (new) The implant of claim 40, wherein said expander is rotated more than one full rotation to move said implant from the collapsed position to the expanded position.

42. (new) The implant of claim 25, wherein said implant has a mid-longitudinal axis and said expander has a screw that rotates in a plane generally perpendicular to the mid-longitudinal axis of said implant to increase the height of said implant.

43. (new) The implant of claim 25, wherein said expander comprises a wedge having a surface at an angle relative to at least one of said upper and lower portions such that movement of said wedge relative to said at least one of said upper and lower portions moves said implant from the collapsed position to the expanded position.

44. (new) The implant of claim 25, wherein said expander has a length in the direction of the length of the implant, said expander having a height in the direction of the height of the implant, the length of said expander being greater than the height of the expander.

45. (new) The implant of claim 25, wherein said expander has a length in the direction of the length of the implant, said expander having a width in a direction perpendicular to the height of the implant, the length of said expander being greater than the width of the expander.

46. (new) The implant of claim 25, wherein said expander is configured to lock said implant into the expanded position.

47. (new) The implant of claim 25, wherein said implant has a width and said expander has a width less than the width of said implant.

48. (new) The implant of claim 25, wherein said portions center said expander within said implant such that an axis of rotation of said expander coincides with the longitudinal axis of said implant.

49. (new) The implant of claim 25, wherein said implant comprises at least three movable portions.

50. (new) The implant of claim 25, wherein said implant comprises at least four movable portions.

51. (new) The implant of claim 25, wherein said portions each at least in part expand from a mid-longitudinal axis when as measured from the collapsed position to the expanded position.

52. (new) The implant of claim 25, wherein said portions move away from a mid-longitudinal axis when said implant moves from the collapsed position to the expanded position.

53. (new) The implant of claim 25, wherein said implant has a width that is less than one-half of the width of the disc space into which said implant is adapted to be inserted.

54. (new) The implant of claim 25, wherein said implant has a width that is approximately 32 mm for use in the lumbar spine.

55. (new) The implant of claim 25, wherein said implant has a generally rectangular cross section along at least a portion of its length.

56. (new) The implant of claim 25, wherein the length has a maximum that is less than the posterior to anterior depth of one of the adjacent vertebral bodies.

57. (new) The implant of claim 25, wherein said implant is adapted for insertion from the posterior aspect of the vertebral bodies.

58. (new) The implant of claim 25, wherein said implant has a height substantially equal to the height of the space created by the removal of disc material from between the adjacent vertebral bodies.

59. (new) The implant of claim 25, said upper and lower portions are parallel to one another over a substantial portion of the length of said implant.

60. (new) The implant of claim 25, wherein said upper and lower portions are substantially planar and parallel when said implant is in the collapsed position.
61. (new) The implant of claim 25, wherein said upper and lower portions are substantially planar and parallel when said implant is in the expanded position.
62. (new) The implant of claim 25, wherein said upper and lower portions are non-arcuate.
63. (new) The implant of claim 25, wherein each of said upper and lower portions have an interior surface, said interior surfaces being spaced apart to define a hollow interior in communication with said openings.
64. (new) The implant of claim 25, wherein at least a portion of at least one of said upper and lower portions have an irregular surface for engaging the adjacent vertebral bodies and for maintaining said implant in place.
65. (new) The implant of claim 64, wherein said irregular surface comprises at least one groove.
66. (new) The implant of claim 25, wherein said upper and lower portions further comprise at least a second opening.
67. (new) The implant of claim 25, wherein at least one of said openings is approximately 1 mm to 3 mm in diameter.
68. (new) The implant of claim 25, wherein at least some of said openings in said upper and lower portions form a channel through said implant.
69. (new) The implant of claim 25, further comprising at least one protrusion extending from said upper and lower portions for engaging the adjacent vertebral bodies to maintain said implant between adjacent vertebral bodies.
70. (new) The implant of claim 69, wherein said protrusion comprises a ridge.
71. (new) The implant of claim 69, wherein said at least ones protrusion comprises ridges facing the same direction to prevent expulsion of said implant in a direction opposite to said same direction.
72. (new) The implant of claim 69, wherein said protrusion comprises a ratchet.

73. (new) The implant of claim 72, wherein said at least ones protrusion comprises ratchets facing the same direction to prevent expulsion of said implant in a direction opposite to said same direction.

74. (new) The implant of claim 25, further comprising opposite sides between said upper and lower portions, and between said leading and trailing ends.

75. (new) The implant of claim 74, wherein said sides having at least one aperture therethrough in communication with said openings in said upper and lower portions.

76. (new) The implant of claim 74, wherein said sides are generally parallel to one another.

77. (new) The implant of claim 74, wherein said sides are generally flat.

78. (new) The implant of claim 25, wherein one of said upper and lower portions has an interior wall, which is unexposed, extending therefrom toward the other of said upper and lower portions when said implant is in the collapsed position, and when said implant is in the expanded position said implant has a shape such that each of said upper and lower portions are separated by at least a portion of said interior wall, which now has an exposed side.

79. (new) The implant of claim 78, wherein said upper and lower portions have side walls for engaging each other.

80. (new) The implant of claim 79, wherein said side walls of said upper and lower portions are at least partially overlapping walls.

81. (new) The implant of claim 25, wherein said upper and lower portions have walls contacting one another.

82. (new) The implant of claim 81, wherein said walls are aligned parallel with the longitudinal axis of said implant.

83. (new) The implant of claim 81, wherein said walls are at least in part overlapping.

84. (new) The implant of claim 25, said implant being formed at least in part of a material other than bone.

85. (new) The implant of claim 25, wherein said upper and lower portions have a bone ingrowth surface.
86. (new) The implant of claim 25, wherein said implant has an exterior surface that is at least in part porous.
87. (new) The implant of claim 25, wherein said implant is porous.
88. (new) The implant of claim 25, wherein said implant comprises a bone ingrowth material other than bone.
89. (new) The implant of claim 25, further comprising a material that intrinsically participates in the growth of bone from one of the adjacent vertebral bodies to the other of the adjacent vertebral bodies.
90. (new) The implant of claim 25, wherein said implant is treated with a fusion promoting substance.
91. (new) The implant of claim 90, wherein said fusion promoting substance includes bone.
92. (new) The implant of claim 25, wherein said implant is formed of a material that is stronger than bone.
93. (new) The implant of claim 25, in combination with an osteogenic material.
94. (new) The implant of claim 93, wherein said osteogenic material includes a fusion promoting material.
95. (new) The implant of claim 93, wherein said osteogenic material includes bone.
96. (new) The implant of claim 93, wherein said osteogenic material includes paste.